**SMD Operations Procedures Manual**

# 8.1.1.30 OPERATION OF DUAL ACME POWER SUPPLIES

Text Pages 1 through 11
Attachments 1, 2

**Hand Processed Changes**

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# 8.1.1.30 Operation of Dual Acme Power Supplies

## 1.0 Purpose and Scope

1.1 To provide instruction in operating the Dual Acme Power Supply System. The System is located in the Calibration Magnet area on the floor of Building 902. The individual Supplies are labeled "326" and "327".

1.2 Instruction in performing the following tasks is included:

Changing the configuration of the step-down transformer;

Connecting the load to the output of the System;

Activating power to the System;

Operating the System via computer command;

Shutting down the System.

1.3 This procedure does not provide instructions for testing the safety interlocks. That information is contained in RHIC OPM 8.1.1.31.

## 2.0 Responsibilities

2.1 The main actions in this procedure will be performed by an Authorized Operator of the Dual Acme Power Supplies, except as follows:

2.1.1 Section 5.3, "Changing the links on the step-down transformer" may be performed only by those who are qualified by having undergone a formal training session. A list of qualified operators is maintained in the Electrical Systems Section group office.

2.1.2 A list of authorized operators of the Dual Acme Power Supplies shall be maintained by the Electrical Systems Support Section Supervisor and posted on each of the individual supplies.

2.2 The Operator will maintain a log book. Entries will include notes of any irregularities encountered during operation of the Supplies.

## 3.0 Prerequisites

Training:

3.1 The Operator shall be an "authorized employee" as defined by SEAPPM 1.5.1, "Lockout/Tagout Requirements".

3.2 The Operator shall be trained and qualified by the following people:

3.2.1 Cognizant Engineer for the Dual Acme Supply, or the CE's designee.

3.2.2 Cognizant Engineer or Cognizant Scientist for horizontal magnet testing, or the CE/CS's designee.

3.3 An Operator who will perform the steps in section 5.3, "Changing the links on the step-down transformer" , shall be specifically trained for this work during a formal training session.

Minimum Personnel:

3.4 Two operators are required to perform this procedure. One will perform the steps; the other will act as a safety person.

Special Tools and Equipment:

None

## 4.0 Precautions

None

## 5.0 Procedure

5.1 Verify that the safety interlocks have been tested within the past six months.

IF the test approval has expired,

THEN stop work and immediately notify the Cognizant Engineer. Do not continue performing this procedure.

**NOTE** ***A "Safety Interlock Test Approval" form is posted on the front panels of both Supplies. The form indicates the last test date, and the expiration date.***

**WARNING**

**The steps in sections 5.2, 5.3, 5.4, and 5.5 must be performed by two operators. One operator will perform the actual steps. The other operator will act as a safety person.**

5.2 Shutting Off Main A.C. Power to the Supplies

5.2.1 Determine that the DC output of the Dual Acme Power Supplies is deenergized by checking that all of the following conditions are true:

A. No warning lights over the Supplies flashing;

B. "DC VOLTS" and "DC KILOAMPS" analog meters on the front panels of the Supplies read zero.

5.2.2 Place Input Disconnect Switch I-13 in the OPEN position. Check that the contacts are open by observing them through the lexan window.

5.2.3 Using a padlock, lock and tag Switch I-13.

5.2.4 Insert control keys #21 and #22 into the Kirk locks on the Switch. Access keys #23 and #24 should already be in their locks because they are captive. With all four keys in place, turn the keys clockwise until the lock plunger engages the capture plate on the switch handle.

5.2.5 Remove keys #23 and #24 from the Kirk locks on the Switch.

**WARNING**

**You must have undergone formal training in changing the links inside the step-down transformer Link Box before performing the steps in section 5.3**

5.3 Changing the Links on the Step-Down Transformer

**NOTE** ***The steps in this section are performed when a change in the operating voltage of the System is required.***

**WARNING**

**To avoid a severe shock hazard, all of the steps in section 5.2 must be completed before continuing with this section.**

5.3.1 Perform all of the steps in section 5.2.

5.3.2 Verify that the Link Box Voltmeters, on the outside of the step-down transformer Link Box, indicate 0 VAC input.

5.3.3 Open the Link Box using Key #23 for Kirk lock RE10306.

5.3.4 Verify that your Wiggy voltage tester is operational by checking it on a 120 V ac outlet.

5.3.5 Using the Wiggy, verify that the input voltage, line to line and line to ground, is zero.

5.3.6 Verify that the Links and the bus material are free of debris at the mating points.

5.3.7 Connect the Input Transformer Links for the appropriate operating voltage condition. Refer to Attachment 1, "Input Transformer Link Box Diagram". Tighten the nuts securely.

5.3.8 Close the Link Box and remove Key #23. Keep the key on your person.

## 5.4 Accessing the D.C. Output of the Supplies to Connect a Magnet Load

**WARNING**

**To avoid a severe shock hazard, all of the steps in section 5.2 must be completed before continuing with this section.**

5.4.1 Perform all of the steps in section 5.2.

5.4.2 Insert control keys #38 and #40 into the Kirk locks on the contactors on the back of each Acme power supply. Access keys #39 and #41 should already be in their locks because they are captive. With all four keys in place, turn the keys clockwise until the lock plunger extends to block the contactor blade.

5.4.3 Remove keys #39 and #41 from the contactors and insert them into the Kirk locks on the cover panel of the D.C. Output Link Box.

5.4.4 Operate the locks and remove the cover panel.

5.4.5 Verify that the Links and the bus material are free of debris at the connection points.

5.4.6 Connect the D.C Output Links to the magnet load. Refer to Attachment 2, "D.C Output Link Box Diagram".

5.4.7 Tighten the nuts securely.

5.4.8 Replace the cover panel on the Link Box. Tighten the wing nuts. Lock the Kirk locks and remove keys #39 and #41. Keep the keys on your person.

5.4.9 Install connection jumpers for the magnet load.
**NOTE** ***This is not needed for the two calibration magnets.***

5.4.10 Install thermal interlocks on the magnet..

5.4.11 Connect water hoses to the magnet.

5.4.12 Open the return valves for the water cooling system. After opening the return valves, open the supply valves. Check for water leaks and repair if necessary.

5.4.13 IF the magnet load is a booster magnet,

THEN verify that the water heater is operating at 80° F. ±2°.

5.4.14 Place protective covers over the connection jumpers and any exposed bus work.
**NOTE** ***This is not needed for the two calibration magnets.***

5.4.15 Connect the P.S. Interlock Cable from J7 of the Output Filter Assembly to the appropriate connector: either J8 (Dipole Magnet), J9 (Quad magnet), or J10 (Booster Magnet).

5.5 Turning On Main A.C. Power

5.5.1 Perform all steps in sections 5.3 and 5.4.

5.5.2 Turn on the control computer. At the "C:" prompt, type BOOSTER. Wait until the main control screen is displayed.

**NOTE** ***The main control screen is divided into three sections:***

***1.A "menu" section that displays the functions assigned to the function keys;***

***2.A "status" section that displays the current values for various software and hardware parameters;***

***3.A "command" section that allows the operator to type in commands to the system and receive messages from the system.***

5.5.3 Verify that the correct version of the software is running by observing the phrase `BOOSTER HARMONIC PROGRAM V9.1.92` displayed on the screen.

5.5.4 Verify that no bus error messages are displayed. Ignore faults indicated on the screen inside the "Faults" field in the "status" section of the menu.

5.5.5 Verify that the light labeled "Closed", located above Switch I-13, is lit. This indicates that Substation Breaker #17, which feeds I-13, is on.

5.5.6 Insert keys #23 and #24 into the Kirk locks on I-13 and unlock the Switch.

5.5.7 Remove the padlock from I-13.

5.5.8 Place I-13 in the CLOSED position and visually check through the side window that the switch contacts are closed.

5.5.9 Verify that the voltmeters on the step-down transformer Link Box indicate 460 Vac input, ±25 Vac.

5.5.10 Remove keys #21 and #22 from Switch I-13 and keep them in a controlled location.

5.6 Preparing the Supplies for Operation

5.6.1 Turn on the blowers for both Supplies.

5.6.2 Clear faults on the annunciator assembly on the front panel of each Supply.

5.6.3 Reset the "under voltage" breaker relay.

5.6.4 Reset the circuit breaker in the rear of each Supply by carefully toggling the lever down and up.

5.6.5 Insert keys #39 and #41 into the Kirk locks for the contactors and unlock the locks.

**NOTE** ***This will enable the contactors so that they may be energized under computer command.***

5.6.6 Remove keys #38 and #40 and keep them in a controlled location.

5.6.7 Verify that power is applied to the Output Filter Assembly and the Remote Control Rack.

5.7 Operating Remotely

5.7.1 Set up the Remote Control Rack for the load using information in the applicable Acceptance Test Procedure.

**CAUTION**

**Attempting to turn on the Supplies if the voltage levels described in step 5.7.2 are exceeded could cause the Supplies to ramp up.**

5.7.2 Verify that the two panel meters located below the computer on the Remote Control Rack read as follows:

A0 Meter labeled "Meter #1 P.S. Drive" indicates a voltage of less then 2.1 Vdc.

**NOTE** ***The meter reads the input voltage to the SCR firing circuits.***

B0 Meter labeled "Meter #2 Ref. Volts" indicates less than 1 mV.

**NOTE** ***The meter reads the control voltage output of the Regulator Card.***

5.7.3 Clear faults by pressing *F5+:PS RESET. Verify that all faults clear.

5.7.4 Choose a mode of operation as follows:

A0 LEVEL mode
The control software defaults to this mode upon initialization.

B0 SLOW INTEGRAL mode

Press *F3+: LOAD PS FILE.

At the ">" prompt, type the desired file name, which will begin with an "S". For example: type `S1030`. Do not type the "dat" filename extension.

**NOTE** ***The file name contains data that will cause the system to produce a waveform that is trapezoidal, with a slope of 8.5 kAmps/sec and a flat top current. The level of the current***

***depends on the file. In the example above, file "S1030.dat" will produce a slow integral waveform with a flat top current of 1030 Amps.***

***Available waveforms are: S250, S1030, S1810, S2590, S3370, S4150, S4930.***

C0 FAST INTEGRAL mode

Press *F3+: LOAD PS FILE.

At the ">" prompt, type the desired file name, which will begin with an "F". For example: type `F880`. Do not type the "dat" filename extension.

**NOTE** ***The file name contains data that will cause the system to produce a waveform that is trapezoidal, with a slope of 40.4 kAmps/sec and a flat top current. The level of the current depends on the file. In the example above, file "F880.dat" will produce a fast integral waveform with a flat top current of 880 Amps.***

***Available waveforms are: F640, F880, F1120, F1360, F1600, F1840, F2080, F2320.***

5.7.5 IF you are using the LEVEL mode of operation,

THEN perform the following steps to operate the Supplies:

A0 Observe the status section of the computer screen. Verify that the "PS Command" line indicates "0" and that the "Load File" line indicates "level".

B0 Press *F7+:PS ON to turn on the D.C section of the Supplies.

C0 At the ">" prompt, type the desired final current level and the ramp rate. For example type `PS(1000,25)`to set a final current level of 1000 Amps and a ramp rate of 25 Amps/sec. The Supplies will begin ramping when *Enter+ is pressed.

5.7.6 IF you are using the SLOW INTEGRAL or FAST INTEGRAL mode of operation,

THEN perform the following steps to operate the Supplies:

A0 Observe the status section of the computer screen. Verify that the "PS Command" line indicates "0" and that the "Load File" line indicates the name of the desired waveform file.

B0 Press *F7+:PS ON to turn on the D.C section of the Supplies.

C0 Press *F4+:STOP/START WAVE to begin the ramp.

5.8 Shutting Down the Supplies

5.8.1 Ramp the Supplies to zero as follows:

A0 IF you are using the LEVEL mode of operation,

THEN At the ">" prompt, type `PS(0,100)` and press *Enter+. ???what is the correct ramp rate???

B0 IF you are using the SLOW INTEGRAL or FAST INTEGRAL mode of operation,

THEN press *F4+:STOP/START WAVE.

5.8.2 Press *F8+: PS OFF to turn off the D.C section of the Supplies.

5.8.3 Insert keys #38 and #40 into the Kirk locks for the contactors and lock the locks.

5.8.4 Remove keys #39 and #41 from the Kirk locks and keep them in a controlled location.

5.8.5 Turn off the blowers for both Supplies.

5.8.6 Place I-13 in the OPEN position and visually check through the side window that the switch contacts are open.

5.8.7 Insert keys #21 and #22 into the Kirk locks on I-13 and turn the keys until the lock plunger is fully engaged.

5.8.8 Remove keys #23 and #24 from Switch I-13 and keep them in a controlled location.

5.8.9 Verify that the voltmeters on the step-down transformer Link Box indicate 0 Vac input.

5.8.10 Exit the computer control program by pressing *F10+:EXIT PROGRAM.

## 600 Documentation

6.1 Log book for testing using the Dual Acme Power Supplies.

## 700 References

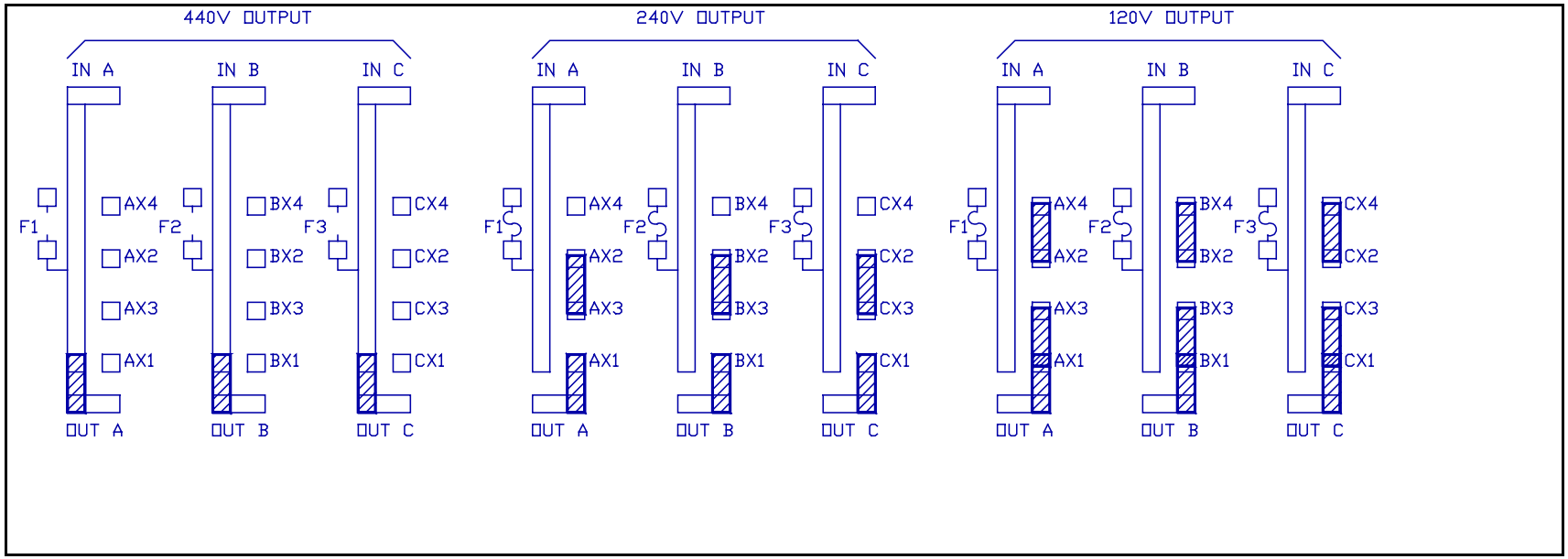
7.1 SEAPPM 1.5.1, "Lockout/Tagout Requirements"

## 800 Attachments

1. Input Transformer Link Box Diagram
2. D.C. Output Link Box Diagram

## Attachment 1

## Input Transformer Link Box Diagram




1. For 440V Output: Short IN to OUT using heavy links, remove fuses.

2. For 240V Output: Short X2 to X3, short X1 to OUT using heavy links, install fuses.

3. For 120V Output: Short X4 to X2, short X3 to X1, short X1 to OUT using heavy links, install fuses.

## Attachment 2

## D.C. Output Link Box Diagram

Shown configured for Calibration Quadrupole magnet.